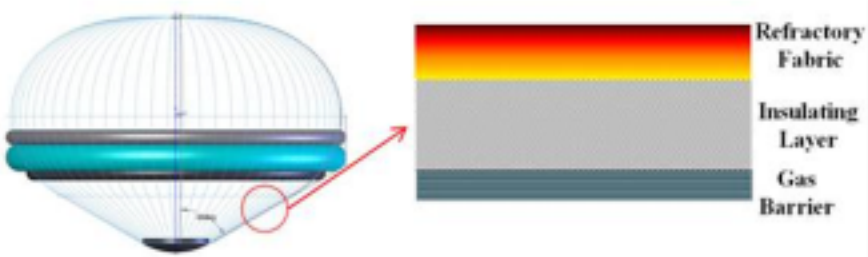
NASA SBIR/STTR Technologies

H5.04-9891 - Development of Hot Structures Materials for Inflatable Heat Shield

PI: Essam Sheta
CFD Research Corporation - Huntsville, AL

Identification and Significance of Innovation

Advanced development of high-temperature resistant fibrous material concepts that do not require parasitic thermal protection systems is essential to meet the low cost, lightweight, durable inflatable structure for future space explorations. CFDRC team proposes a high performance Structural Inflatable Heat Shield featuring a flexible-deployable thermal protection system that simultaneously performs as mass-optimized hot structure capable of supporting the mechanical loads associated with atmospheric entry. The proposed innovation facilitates reduction of heat shield mass fraction by balancing the vehicle entry parameters with heat shield diameter to take maximum advantage of the shield's mechanical and thermal capabilities. An integrated test and analysis plan is established to fully characterize the high-temperature materials for deployable structures and to fully capture the combined effects of processing, microstructure fiber geometry, temperature-related properties and performance.



High performance functionality of flexible (FTPS) for inflatable heat shield

Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)

Technical Objectives and Work Plan

The overall objective of this effort is to develop a high performance Structural Inflatable Heat Shield (SIHS) featuring a flexible-deployable thermal protection system (FTPS) that simultaneously performs as mass-optimized hot structure capable of supporting the mechanical loads associated with atmospheric entry.

Phase I effort will focus on identification and testing of high performance, high-temperature materials to characterize structural and thermal behavior. Material coupon testing and analysis will be conducted on various potential materials (with various fibers, weaves, and brain patterns) to provide a wide range of parametric data for material characterization. Integration method for integrating the proposed FTPS materials with a conceptual IAD architecture hardware will also be investigated for proof of concept. High-fidelity nonlinear thermal structure FEM model specialized for thin inflatable materials will be used to study the thermal and structural responses of the materials. The data will be used to provide computational model correlation and verification. Phase II will focus on fabricating a subscale prototype of FTPS-based inflatable structure, and conduct extensive strain and thermal testing and analysis of the SIHS under different thermal and structural loading conditions

NASA Applications

Direct NASA applications include those missions seeking to provide deceleration and precision landing capability for large scale mass return from Earth orbit, or for missions to many of the potential atmosphere-endowed solar system destinations. Other NASA applications include design and analysis of space-based inflatable structures such as telescopes, antenna reflectors, solar collectors, lander airbags, cryogenic propellant tanks, debris shields, Martian air ships and rover vehicles.

Non-NASA Applications

General applications include satellite de-orbit devices, compressed air energy storage, high altitude airships, aerostats, fuel and oxidizer containment, deep space antenna reflector for ground stations, antenna radome, emergency shelters, and troop shelters with integrated ballistic protection

Firm Contacts

Deb Phipps
CFD Research Corporation
701 McMillian Way NW, Suite D
Huntsville, AL, 35806-2923
PHONE: (256) 726-4800
FAX: (256) 726-4806